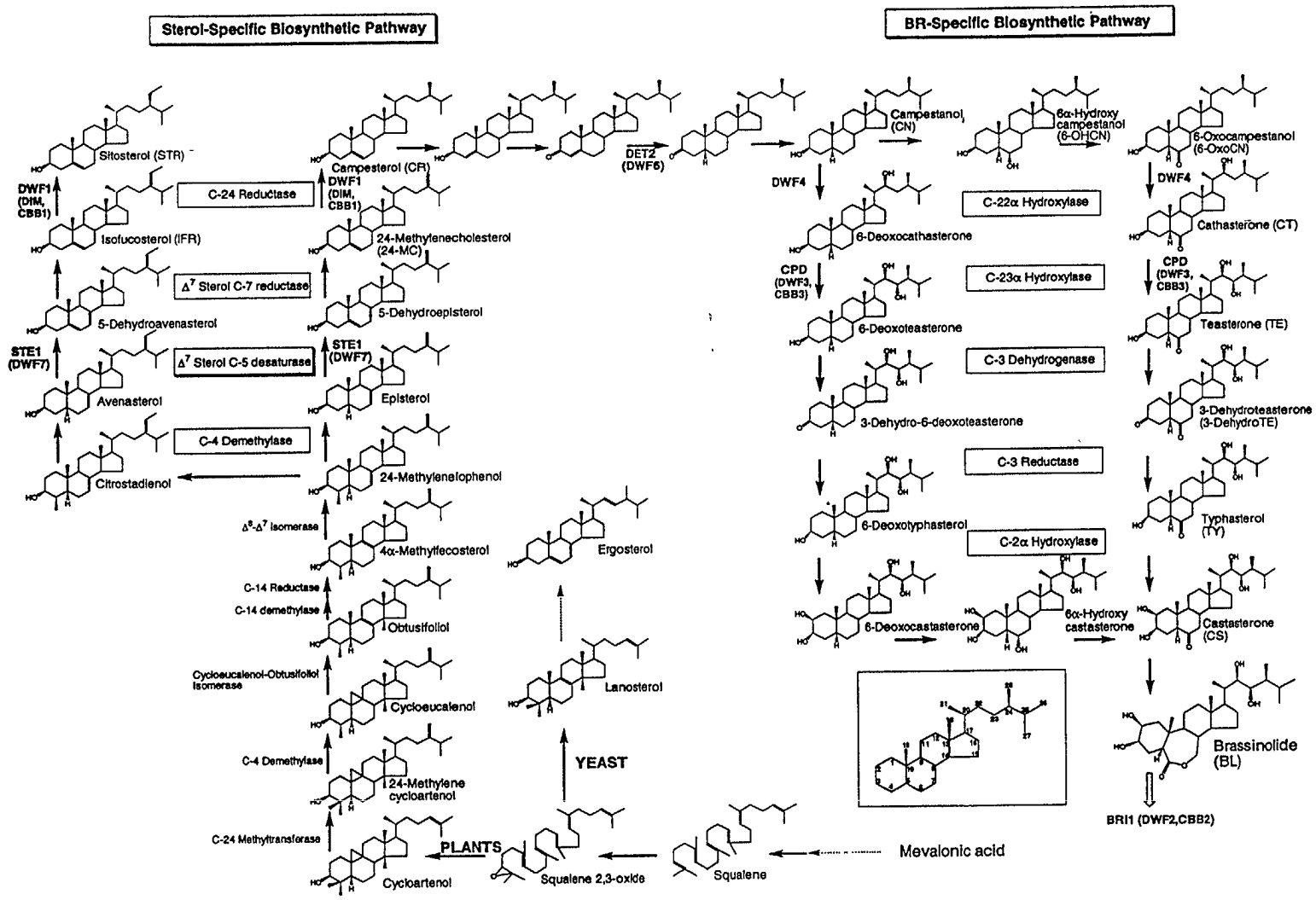
Sterol-Specific Biosynthetic Pathway
BR-Specific Biosynthetic Pathway
Sitosterol (STR)
DWF1 (DIM, CBB1)
Isofucosterol (IFR)
C-24 Reductase
Campesterol (CR)
DWF1 (DIM, CBB1)
24-Methylenecholesterol (24-MC)
Δ7 Sterol C-7 reductase
5-Dehydroavenasterol
5-Dehydroepisterol
STE1 (DWF7)
Δ7 Sterol C-5 desaturase
Avenasterol
Episterol
C-4 Demethylase
Citrostadienol
24-Methyleneiophenol
Δ8-Δ7 Isomerase
4α-Methylfecosterol
Ergosterol
C-14 Reductase
C-14 demethylase
Obtusifoliol
Cycloeucalenol-Obtusifoliol Isomerase
Cycloeucalenol
Lanosterol
C-4 Demethylase
24-Methylene cycloartenol
YEAST
C-24 Methyltransferase
PLANTS
Cycloartenol
Squalene 2,3-oxide
Squalene
Mevalonic acid
DET2 (DWF6)
Campestanol (CN)
DWF4
6α-Hydroxy campestanol (6-OHCN)
6-Oxocampestanol (6-OxoCN)
6-Deoxocathasterone
C-22α Hydroxylase
Cathasterone (CT)
CPD (DWF3, CBB3)
C-23α Hydroxylase
6-Deoxoteasterone
Teasterone (TE)
C-3 Dehydrogenase
3-Dehydro-6-deoxoteasterone
3-Dehydroteasterone (3-DehydroTE)
C-3 Reductase
6-Deoxotyphasterol
Typhasterol (TY)
C-2α Hydroxylase
6-Deoxocastasterone
6α-Hydroxy castasterone
Castasterone (CS)
Brassinolide (BL)
BRI1 (DWF2,CBB2)

FIG. 1

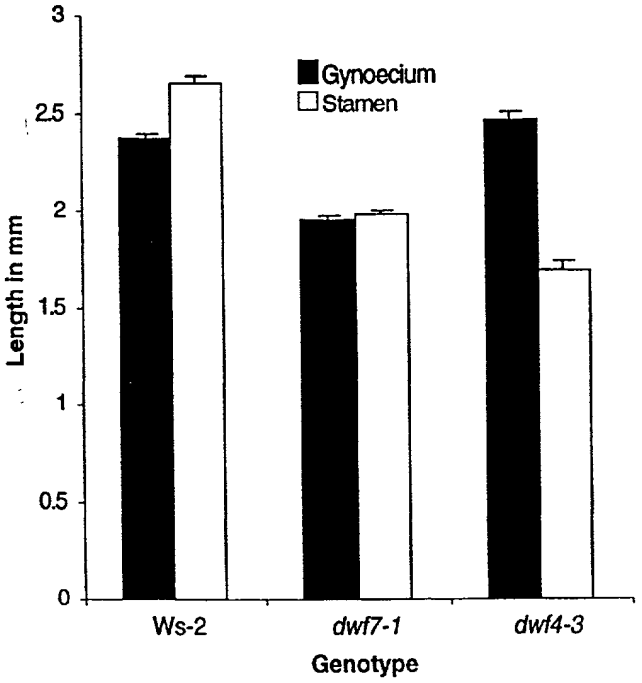
3
2.5
2
1.5
1
0.5
0
Length in mm
Gynoecium
Stamen
Ws-2
dwf7-1
dwf4-3
Genotype

FIG. 2

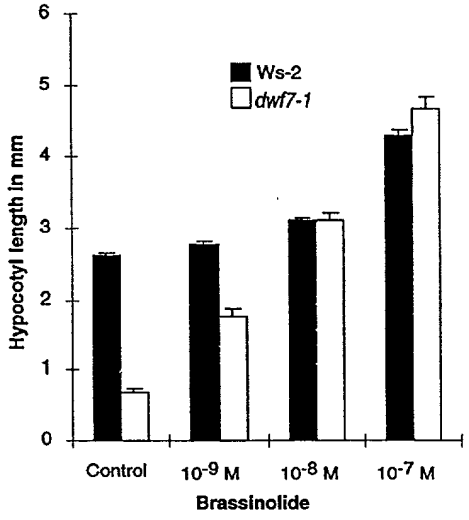
6
5
4
3
2
1
0
Hypocotyl length in mm
Ws-2
dwf7-1
Control
10-9 M
10-8 M
10-7 M
Brassinolide

FIG. 3

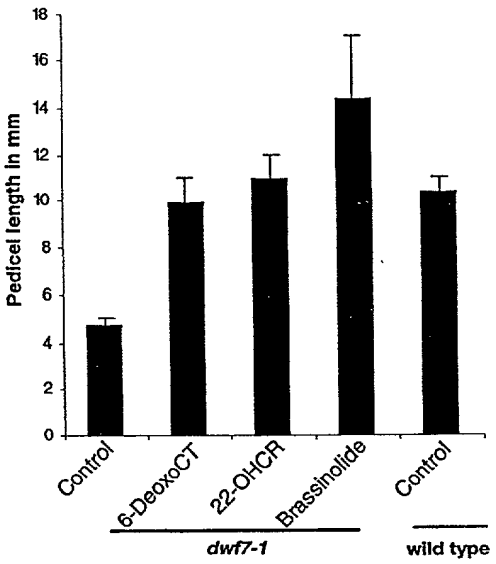
Pedicel length in mm
18
16
14
12
10
8
6
4
2
0
Control
6-DeoxoCT
22-OHCR
Brassinolide
Control
dwf7-1
wild type

FIG. 4

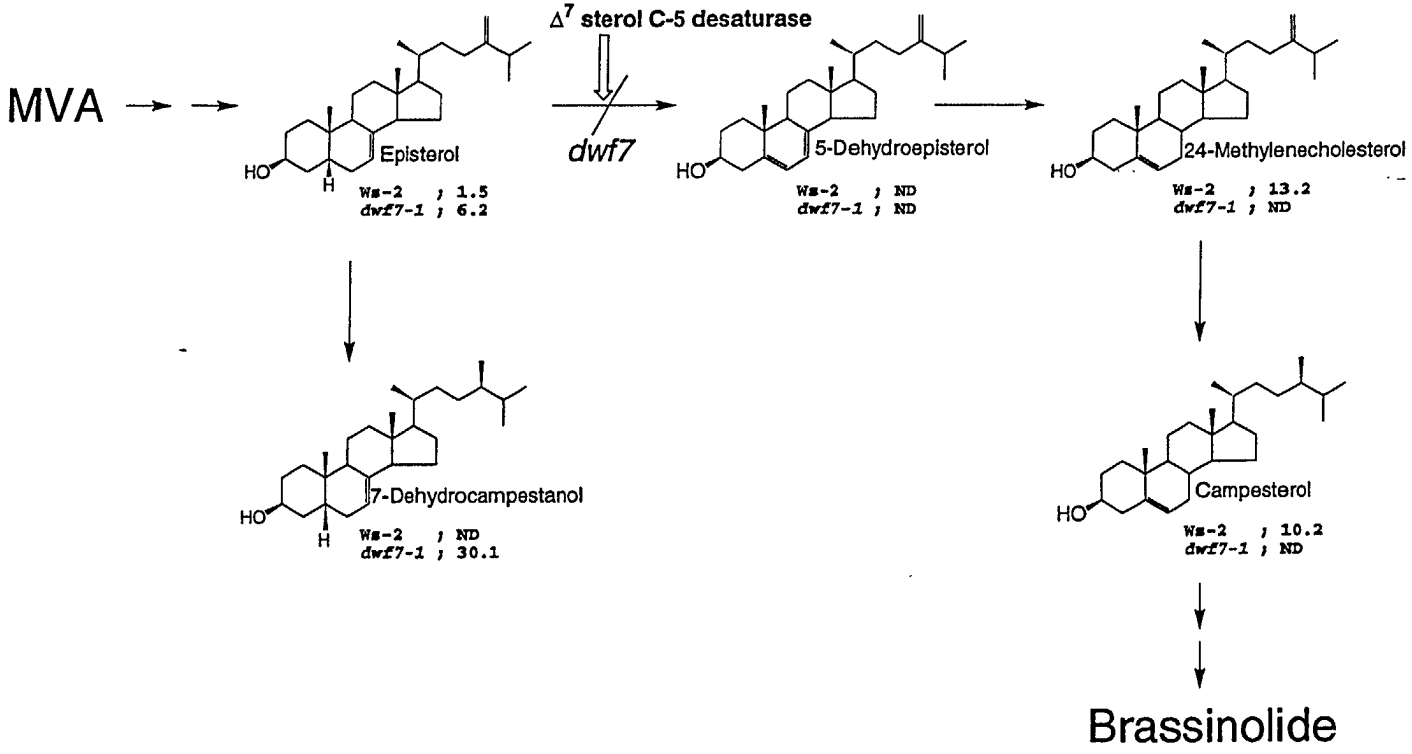
MVA
Δ7 sterol C-5 desaturase
dwf7
Episterol
Ws-2 ; 1.5
dwf7-1 ; 6.2
5-Dehydroepisterol
Ws-2 ; ND
dwf7-1 ; ND
24-Methylenecholesterol
Ws-2 ; 13.2
dwf7-1 ; ND
7-Dehydrocampestanol
Ws-2 ; ND
dwf7-1 ; 30.1
Campesterol
Ws-2 ; 10.2
dwf7-1 ; ND
Brassinolide

FIG. 5

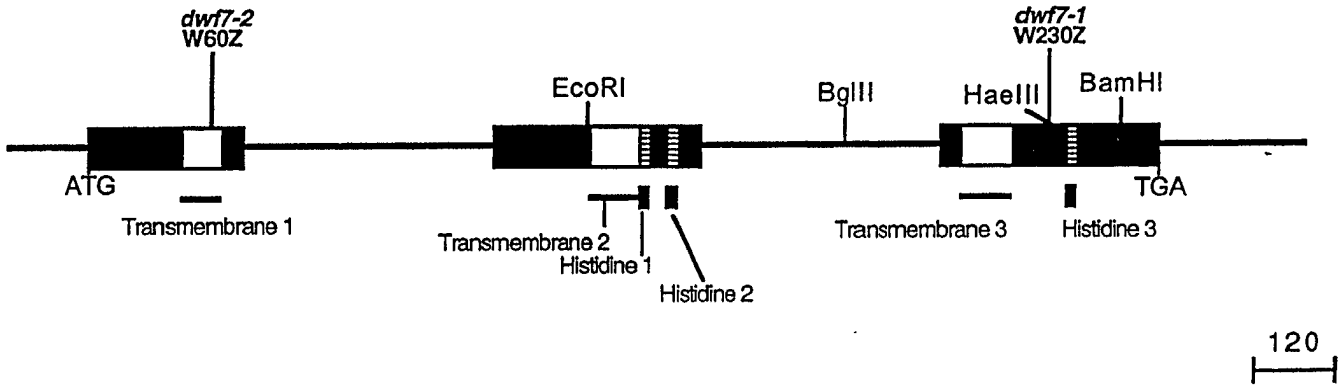

FIG. 6

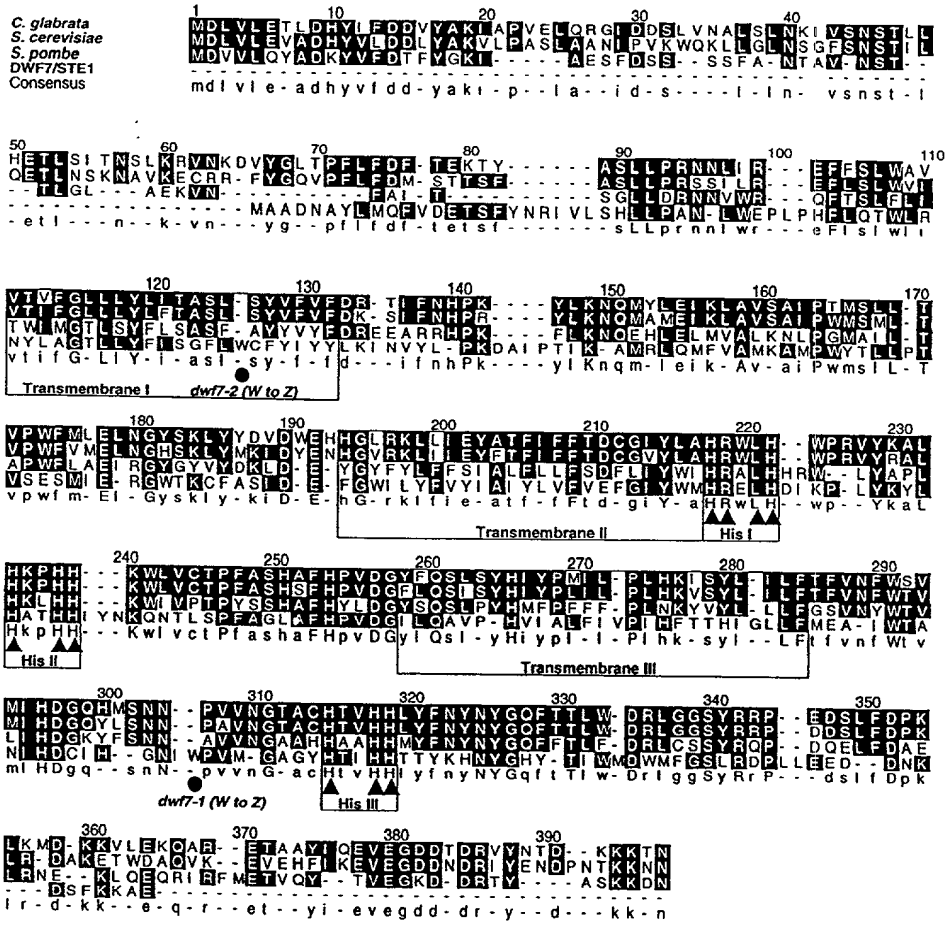
C. glabrata
S. cerevisiae
S. pombe
DWF7/STE1
Consensus
Transmembrane I
dwf7-2 (W to Z)
Transmembrane II
His I
His II
Transmembrane III
dwf7-1 (W to Z)
His III

FIG. 7

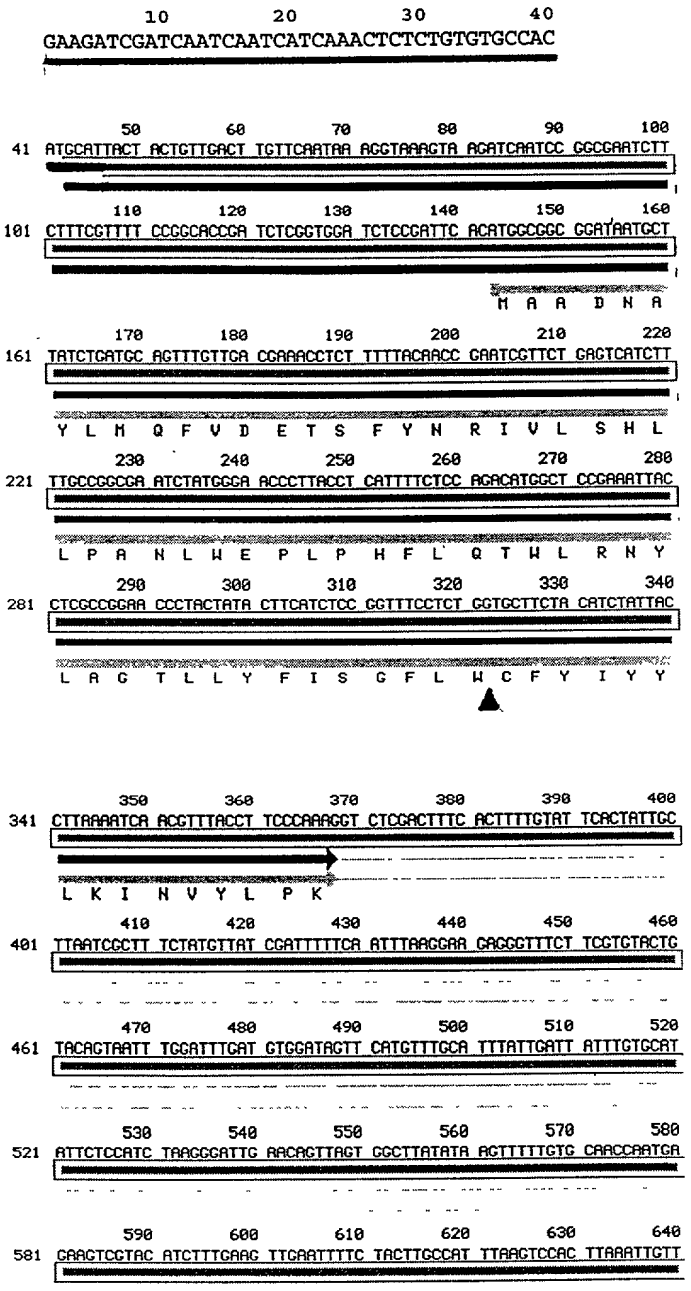
10 20 30 40
GAAGATCGATCAATCAATCATCAAACTCTCTGTGTGCCAC
50 60 70 80 90 100
41 ATGCATTACT ACTGTTGACT TGTTCAATAA AGGTAAAGTA AGATCAATCC GGCGAATCTT
110 120 130 140 150 160
101 CTTTCGTTTT CCGGCACCGA TCTCGGTGGA TCTCCGATTC ACATGGCGGC GGATAATGCT
M A A D N A
170 180 190 200 210 220
161 TATCTGATGC AGTTTGTTGA CGAAACCTCT TTTTACAACC GAATCGTTCT GAGTCATCTT
Y L M Q F V D E T S F Y N R I V L S H L
230 240 250 260 270 280
221 TTGCCCGGCGA ATCTATGGGA ACCCTTACCT CATTTTCTCC AGACATGGCT CCGAAATTAC
L P A N L W E P L P H F L Q T W L R N Y
290 300 310 320 330 340
281 CTCGCCGGAA CCCTACTATA CTTCATCTCC GGTTTCCTCT GGTGCTTCTA CATCTATTAC
L A G T L L Y F I S G F L W C F Y I Y Y
350 360 370 380 390 400
341 CTTAAAATCA ACGTTTACCT TCCCAAAGGT CTCGACTTTC ACTTTTGTAT TCACTATTGC
L K I N V Y L P K
410 420 430 440 450 460
401 TTAATCGCTT TCTATGTTAT CGATTTTTCA ATTTAAGGAA GAGGGTTTCT TCGTGTACTG
470 480 490 500 510 520
461 TACAGTAATT TGGATTTGAT GTGGATAGTT CATGTTTGCA TTTATTGATT ATTTGTGCAT
530 540 550 560 570 580
521 ATTCTCCATC TAACGCATTG AACAGTTAGT GGCTTATATA AGTTTTTGTG CAACCAATGA
590 600 610 620 630 640
581 GAAGTCGTAC ATCTTTGAAG TTGAATTTTC TACTTGCCAT TTAAGTCCAC TTAAATTGTT

FIG. 8A

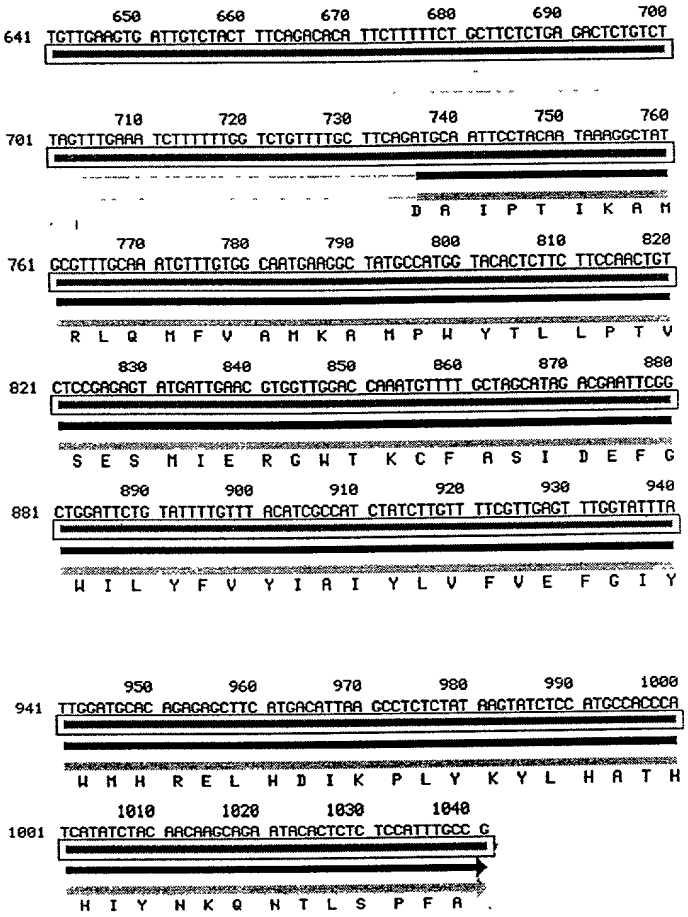
650 660 670 680 690 700
641 TGTTGAAGTG ATTGTCTACT TTCAGACACA TTCTTTTTCT GCTTCTCTGA GACTCTGTCT
710 720 730 740 750 760
701 TAGTTTGAAA TCTTTTTTGG TCTGTTTTGC TTCAGATGCA ATTCCTACAA TAAAGGCTAT
D A I P T I K A M
770 780 790 800 810 820
761 GCCTTTGCAA ATGTTTGTGG CAATGAAGGC TATGCCATGG TACACTCTTC TTCCAACTGT
R L Q M F V A M K A M P W Y T L L P T V
830 840 850 860 870 880
821 CTCCGAGAGT ATGATTGAAC GTGGTTGGAC CAAATGTTTT GCTAGCATAG ACGAATTCGG
S E S M I E R G W T K C F A S I D E F G
890 900 910 920 930 940
881 CTGGATTCTG TATTTTGTTT ACATCGCCAT CTATCTTGTT TTCGTTGAGT TTGCTATTTA
W I L Y F V Y I A I Y L V F V E F G I Y
950 960 970 980 990 1000
941 TTGGATGCAC AGAGAGCTTC ATGACATTAA GCCTCTCTAT AAGTATCTCC ATGCCACCCA
W M H R E L H D I K P L Y K Y L H A T H
1010 1020 1030 1040
1001 TCATATCTAC AACAAGCAGA ATACACTCTC TCCATTTGCC G
H I Y N K Q N T L S P F A

FIG. 8B

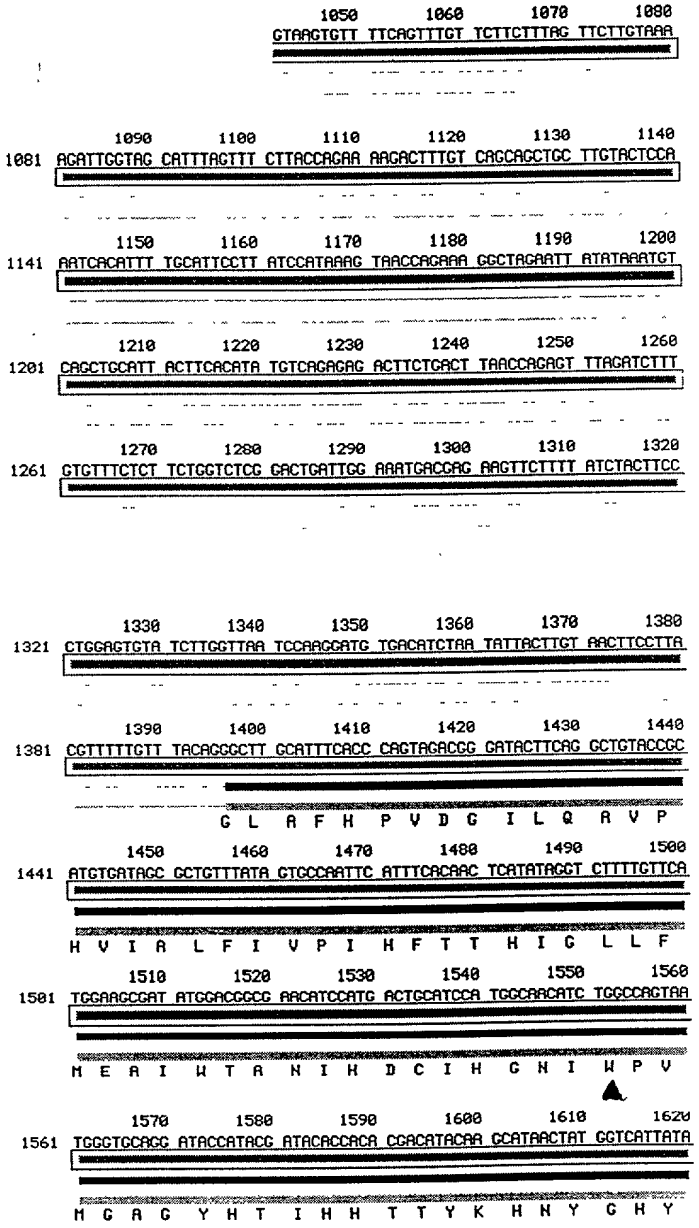
1050 1060 1070 1080
GTAAGTGTT TTCAGTTTGT TCTTCTTTAG TTCTTGTAAA
1090 1100 1110 1120 1130 1140
1081 AGATTGCTAG CATTTAGTTT CTTACCAGAA AAGACTTTGT CAGCAGCTGC TTGTACTCCA
1150 1160 1170 1180 1190 1200
1141 AATCACATTT TGCATTCCTT ATCCATAAAG TAACCAGAAA GGCTAGAATT ATATAAATCT
1210 1220 1230 1240 1250 1260
1201 CAGCTGCATT ACTTCACATA TGTCAGAGAG ACTTCTGACT TAACCAGAGT TTAGATCTTT
1270 1280 1290 1300 1310 1320
1261 GTGTTTCTCT TCTGGTCTCG GACTGATTGG AAATGACGAG AAGTTCTTTT ATCTACTTCC
1330 1340 1350 1360 1370 1380
1321 CTGGAGTGTA TCTTGGTTAA TCCAAGGATG TGACATCTAA TATTACTTGT AACTTCCTTA
1390 1400 1410 1420 1430 1440
1381 CGTTTTTGTT TACAGGCTT GCATTTCACC CAGTAGACGG GATACTTCAG GCTGTACCGC
G L R F H P V D G I L Q R V P
1450 1460 1470 1480 1490 1500
1441 ATGTGATAGC GCTGTTTATA GTGCCAATTC ATTTCACAAC TCATATAGGT CTTTTGTTCA
H V I A L F I V P I H F T T H I G L L F
1510 1520 1530 1540 1550 1560
1501 TGGAAGCGAT ATGGACGCCG AACATCCATG ACTGCATCCA TGCCAACATC TGCCAGTAA
M E A I W T A N I H D C I H G N I W P V
1570 1580 1590 1600 1610 1620
1561 TGGGTGCAGC ATACCATACG ATACACCACA CGACATACAA GCATAACTAT GGTCATTATA
M G A G Y H T I H H T T Y K H N Y G H Y

FIG. 8C

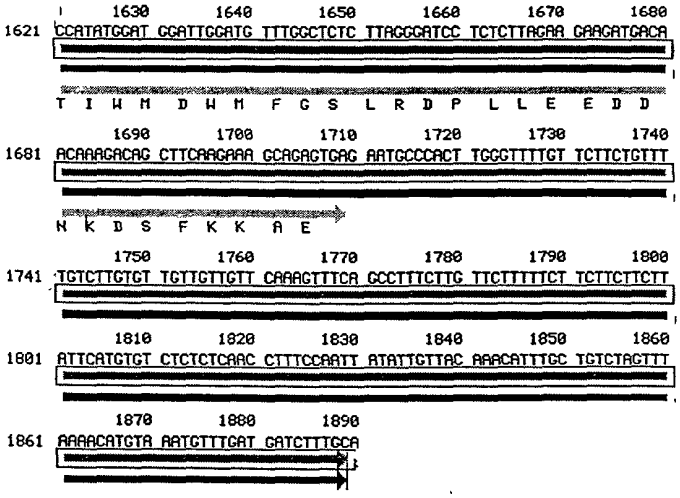
1630 1640 1650 1660 1670 1680
1621 CCATATGGAT GGATTGGATG TTTGGCTCTC TTAGGGATCC TCTCTTAGAA GAAGATGACA
T I W M D W M F G S L R D P L L E E D D
1690 1700 1710 1720 1730 1740
1681 ACAAAGACAG CTTCAAGAAA GCAGAGTGAG AATGCCCACT TGGGTTTTGT TCTTCTGTTT
N K D S F K K A E
1750 1760 1770 1780 1790 1800
1741 TGTCTTGTGT TGTTGTTGTT CAAAGTTTCA GCCTTTCTTG TTCTTTTTCT TCTTCTTCTT
1810 1820 1830 1840 1850 1860
1801 ATTCATGTGT CTCTCTCAAC CTTTCCAATT ATATTGTTAC AAACATTTGC TGTCTAGTTT
1870 1880 1890
1861 AAAACATGTA AATGTTTGAT GATCTTTGCA

FIG. 8D

```
  1   MAADNAYLMQ FVDETSFYNR IVLSHLLPAN LWEPLPHFLQ TWLRNYLAGT
 51   LLYFISGFLW CFYIYYLKIN VYLPKDAIPT IKAMRLQMFV AMKAMPWYTL
101   LPTVSESMIE RGWTKCFASI DEFGWILYFV YIAIYLVFVE FGIYWMHREL
151   HDIKPLYKYL HATHHIYNKQ NTLSPFAGLA FHPVDGILQA VPHVIALFIV
201   PIHFTTHIGL LFMEAIWTAN IHDCIHGNIW PVMGAGYHTI HHTTYKHNYG
251   HYTIWMDWMF GSLRDPLLEE DDNKDSFKKA E
```

FIG. 9

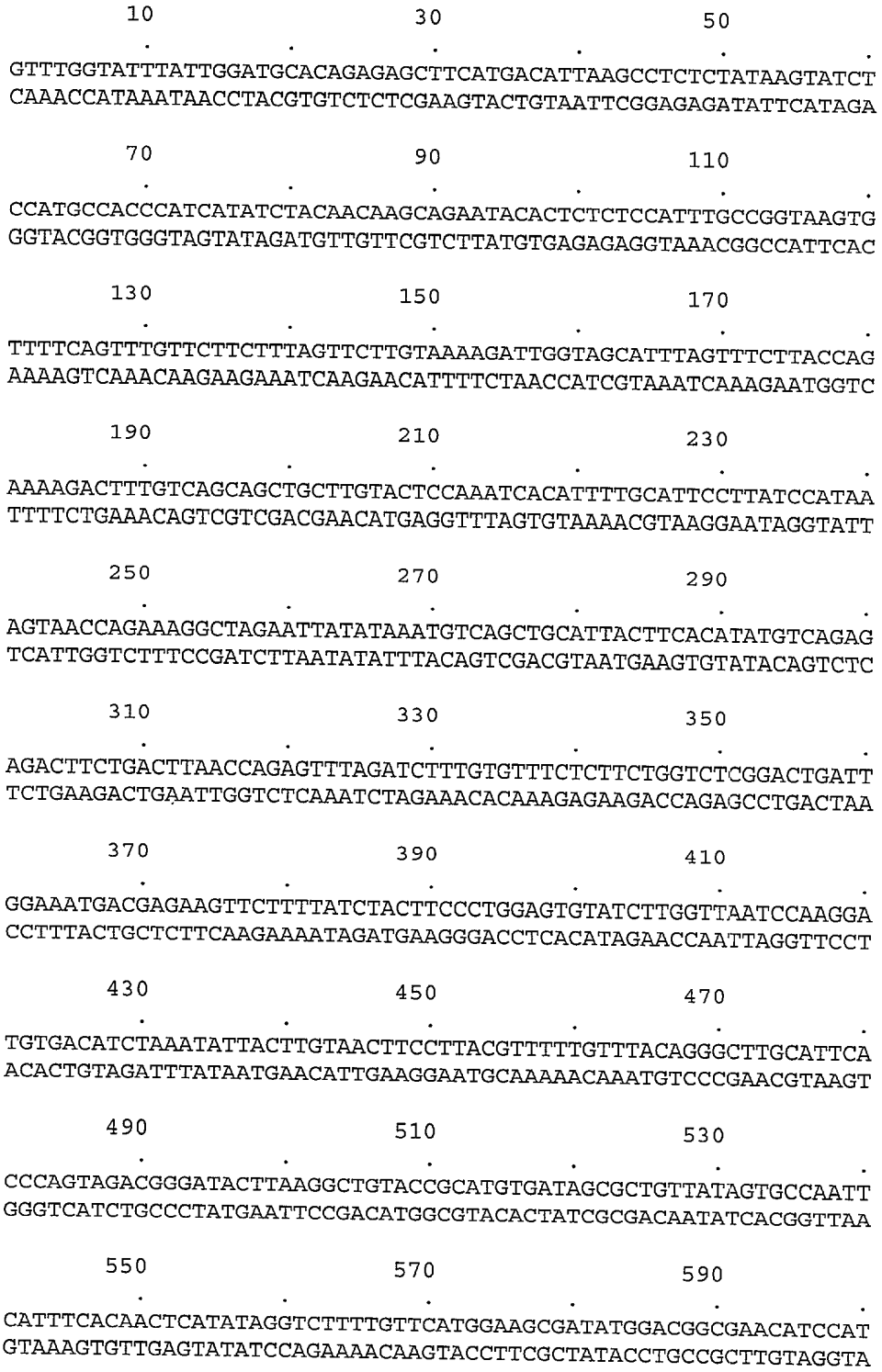
10
30
50
GTTTGGTATTTATTGGATGCACAGAGAGCTTCATGACATTAAGCCTCTCTATAAGTATCT
CAAACCATAAATAACCTACGTGTCTCTCGAAGTACTGTAATTCGGAGAGATATTCATAGA
70
90
110
CCATGCCACCCATCATATCTACAACAAGCAGAATACACTCTCTCCATTTGCCGGTAAGTG
GGTACGGTGGGTAGTATAGATGTTGTTCGTCTTATGTGAGAGAGGTAAACGGCCATTCAC
130
150
170
TTTTCAGTTTGTTCTTCTTTAGTTCTTGTAAAAGATTGGTAGCATTTAGTTTCTTACCAG
AAAAGTCAAACAAGAAGAAATCAAGAACATTTTCTAACCATCGTAAATCAAAGAATGGTC
190
210
230
AAAAGACTTTGTCAGCAGCTGCTTGTACTCCAAATCACATTTTGCATTCCTTATCCATAA
TTTTCTGAAACAGTCGTCGACGAACATGAGGTTTAGTGTAAAACGTAAGGAATAGGTATT
250
270
290
AGTAACCAGAAAGGCTAGAATTATATAAATGTCAGCTGCATTACTTCACATATGTCAGAG
TCATTGGTCTTTCCGATCTTAATATATTTACAGTCGACGTAATGAAGTGTATACAGTCTC
310
330
350
AGACTTCTGACTTAACCAGAGTTTAGATCTTTGTGTTTCTCTTCTGGTCTCGGACTGATT
TCTGAAGACTGAATTGGTCTCAAATCTAGAAACACAAAGAGAAGACCAGAGCCTGACTAA
370
390
410
GGAAATGACGAGAAGTTCTTTTATCTACTTCCCTGGAGTGTATCTTGGTTAATCCAAGGA
CCTTTACTGCTCTTCAAGAAAATAGATGAAGGGACCTCACATAGAACCAATTAGGTTCCT
430
450
470
TGTGACATCTAAATATTACTTGTAACTTCCTTACGTTTTTGTTTACAGGGCTTGCATTCA
ACACTGTAGATTTATAATGAACATTGAAGGAATGCAAAAACAAATGTCCCGAACGTAAGT
490
510
530
CCCAGTAGACGGGATACTTAAGGCTGTACCGCATGTGATAGCGCTGTTATAGTGCCAATT
GGGTCATCTGCCCTATGAATTCCGACATGGCGTACACTATCGCGACAATATCACGGTTAA
550
570
590
CATTTCACAACTCATATAGGTCTTTTGTTCATGGAAGCGATATGGACGGCGAACATCCAT
GTAAAGTGTTGAGTATATCCAGAAAACAAGTACCTTCGCTATACCTGCCGCTTGTAGGTA

FIG. 10A

```
       610                 630                 650
        .         .         .         .         .         .
GACTGCATCCATGGCAACATCTGGCCAGTAATGGGTGCAGGATACCATACGATACACCAC
CTGACGTAGGTACCGTTGTAGACCGGTCATTACCCACGTCCTATGGTATGCTATGTGGTG

       670                 690                 710
        .         .         .         .         .         .
ACGACATACAAGCATAACTATGGTCATTATACCATATGGATGGATTGGATGTTTGGCTCT
TGCTGTATGTTCGTATTGATACCAGTAATATGGTATACCTACCTAACCTACAAACCGAGA

       730                 750                 770
        .         .         .         .         .         .
CTTAGGGATCCTCTCTTAGAAGAAGATGACAACAAAGACAGCTTCAAGAAAGCAGAGTGA
GAATCCCTAGGAGAGAATCTTCTTCTACTGTTGTTTCTGTCGAAGTTCTTTCGTCTCACT

       790                 810                 830
        .         .         .         .         .         .
GAATGCCCACTTGGGTTTTGTTCTTCTGTTTTGTCTTGTGTTGTTGTTGTTCAAAGTTTC
CTTACGGGTGAACCCAAAACAAGAAGACAAAACAGAACACAACAACAACAAGTTTCAAAG

       850                 870                 890
        .         .         .         .         .         .
AGCCTTTCTTGTTCTTTTTCTTCTTCTTCTTATTCATGTGTCTCTCTCAACCTTTCCAAT
TCGGAAAGAACAAGAAAAAGAAGAAGAAGAATAAGTACACAGAGAGAGTTGGAAAGGTTA

       910                 930                 950
        .         .         .         .         .         .
TATATTGTTACAAACATTTGCTGTCTAGTTTAAAACATGTAAATGTTTGATGATCTTTGC
ATATAACAATGTTTGTAAACGACAGATCAAATTTTGTACATTTACAAACTACTAGAAACG

       970                 990                1010
        .         .         .         .         .         .
AAGACTCCATTTTTGTTTAAGGTAAACCTTGAATCTCATAGATTGTCGATTGTTGGTATT
TTCTGAGGTAAAAACAAATTCCATTTGGAACTTAGAGTATCTAACAGCTAACAACCATAA

      1030                1050                1070
        .         .         .         .         .         .
TCCATTTTCAGGTACGGTTCTGTAGACTGTAGTCTTGCTGACCAGTCCGGCTTAACCACC
AGGTAAAAGTCCATGCCAAGACATCTGACATCAGAACGACTGGTCAGGCCGAATTGGTGG

      1090                1110                1130
        .         .         .         .         .         .
CCAAATTTCAAAGATCTCAcCAATCAAAATGCTGGCTGGCCCCAATATATAGATGGGCCA
GGTTTAAAGTTTCTAGAGTgGTTAGTTTTACGACCGACCGGGGTTATATATCTACCCGGT

      1150                1170                1190
        .         .         .         .         .         .
GTTAATCCGTCTAGCTTTACTCTTTAGACCTACCTTAGACAGTTAGACACCTGCTAATTA
CAATTAGGCAGATCGAAATGAGAAATCTGGATGGAATCTGTCAATCTGTGGACGATTAAT
```

FIG. 10B

```
      1210                1230                1250
         .         .         .         .         .         .
ATGAGTTTCCTTTTTCTTGTTCAGCAAGTTACCTGTGTTACTTGAGAGTTGAGTTAATGG
TACTCAAAGGAAAAAGAACAAGTCGTTCAATGGACACAATGAACTCTCAACTCAATTACC

      1270                1290                1310
         .         .         .         .         .         .
TAGTAAACGCAATTTAACCCTTATAAGTTTAATCGTATTCAACGAATGACCCAGAGACTT
ATCATTTGCGTTAAATTGGGAATATTCAAATTAGCATAAGTTGCTTACTGGGTCTCTGAA

      1330                1350                1370
         .         .         .         .         .         .
TAAATAAATCCATCGTAACCCTCCACTTCAAAATTCTTTTTAAAAAGTAGCAAATCATTT
ATTTATTTAGGTAGCATTGGGAGGTGAAGTTTTAAGAAAAATTTTTCATCGTTTAGTAAA

      1390                1410                1430
         .         .         .         .         .         .
AAATATTGTAAGTTTGCTTCATTCGAAATTGTAGCTACAGATCTCAAAGCTCCTCCTGTT
TTTATAACATTCAAACGAAGTAAGCTTTAACATCGATGTCTAGAGTTTCGAGGAGGACAA

      1450                1470                1490
         .         .         .         .         .         .
GGCCATATCTCTCTCTAACAAACGCATAGTAACACTTGACCACAGTTTGACTTCTCGGCG
CCGGTATAGAGAGAGATTGTTTGCGTATCATTGTGAACTGGTGTCAAACTGAAGAGCCGC

      1510                1530                1550
         .         .         .         .         .         .
GTTTCATGGCGGCGACTATGGCAGATTATAATGATCAGATCGTCAATGAGACCTCTTTTT
CAAAGTACCGCCGCTGATACCGTCTAATATTACTAGTCTAGCAGTTACTCTGGAGAAAAA
     M   A   A   T   M   A   D   Y   N   D   Q   I   V   N   E   T   S   F   Y

      1570                1590                1610
         .         .         .         .         .         .
ACAACCGAAtGGTTCTGAGTCACCTTTTGCCGgTGAATCTATGGGAACCTTTACCaCATT
TGTTGGCTTaCCAAGACTCAGTGGAAAACGGCcACTTAGATACCCTTGGAAATGGtGTAA
  N   R   M   V   L   S   H   L   L   P   V   N   L   W   E   P   L   P   H   F

      1630                1650                1670
         .         .         .         .         .         .
TCCTCCAGACATGGCTCCGGAACTACCTCGCCGGAAACATACTCTACTTCATCTCCGGCT
AGGAGGTCTGTACCGAGGCCTTGATGGAGCGGCCTTTGTATGAGATGAAGTAGAGGCCGA
  L   Q   T   W   L   R   N   Y   L   A   G   N   I   L   Y   F   I   S   G   F

      1690                1710                1730
         .         .         .         .         .         .
TCCTCTGGTGCTTCTACATCTATTACCTTAAACTCAACGTTTACGTCCCCAAAGGTTACT
AGGAGACCACGAAGATGTAGATAATGGAATTTGAGTTGCAAATGCAGGGGTTTCCAATGA
  L   W   C   F   Y   I   Y   Y   L   K   L   N   V   Y   V   P   K
```

FIG. 10C

```
      1750                1770                1790
         .         .         .         .         .         .
TTTTTCAATTTCGATGTTCTGTTTTGAAACCTTTCTTTTGTTGATTCCTTCGATTGTATC
AAAAAGTTAAAGCTACAAGACAAAACTTTGGAAAGAAAACAACTAAGGAAGCTAACATAG

      1810                1830                1850
         .         .         .         .         .         .
GCCTGATAGATTGTGTTATACGTTAACCTTTTTTTCTTACTGTTACTTTCAGTTCTTGTC
CGGACTATCTAACACAATATGCAATTGGAAAAAAAGAATGACAATGAAAGTCAAGAACAG

      1870                1890                1910
         .         .         .         .         .         .
TTCTACTTCTCATTTAATTAGTTTTAAAGTTTAATATTTTTGGCTAATCCACATTTTTTA
AAGATGAAGAGTAAATTAATCAAAATTTCAAATTATAAAAACCGATTAGGTGTAAAAAAT

      1930                1950                1970
         .         .         .         .         .         .
AGTTGAATCTTCCATGAAATTTGAGCTCAAAATATACCATGAAATTGAAATTTGTGGTTC
TCAACTTAGAAGGTACTTTAAACTCGAGTTTTATATGGTACTTTAACTTTAAACACCAAG

      1990                2010                2030
         .         .         .         .         .         .
TTAGTTCTATTTCTTGCTTGGTTTCTTCTATTTTTGTGGTTAGAATCCATTCCTACGAGA
AATCAAGATAAAGAACGAACCAAAGAAGATAAAAACACCAATCTTAGGTAAGGATGCTCT
                                          E   S   I   P   T   R

      2050                2070                2090
         .         .         .         .         .         .
AAGGCAATGCTTTTGCAAATATACGTGGCAATGAAGGCTATGCCTTGGTACACTCTTCTT
TTCCGTTACGAAAACGTTTATATGCACCGTTACTTCCGATACGGAACCATGTGAGAAGAA
K   A   M   L   L   Q   I   Y   V   A   M   K   A   M   P   W   Y   T   L   L

      2110                2130                2150
         .         .         .         .         .         .
CCAGCTGTCTCTGAGTATATGATCGAGCATGGTTGGACCAAATGTTACTCTACACTTGAC
GGTCGACAGAGACTCATATACTAGCTCGTACCAACCTGGTTTACAATGAGATGTGAACTG
P   A   V   S   E   Y   M   I   E   H   G   W   T   K   C   Y   S   T   L   D

      2170                2190                2210
         .         .         .         .         .         .
CATTTCAACTGGTTCCTCTGTTTCCTCTACATAGCTCTCTATCTTGTTTTAGTTGAGTTt
GTAAAGTTGACCAAGGAGACAAAGGAGATGTATCGAGAGATAGAACAAAATCAACTCAAa
H   F   N   W   F   L   C   F   L   Y   I   A   L   Y   L   V   L   V   E   F

      2230                2250                2270
         .         .         .         .         .         .
ATGATTTATTGGGTTCACAAAGAGCTTCATGACATTAAATTTCTCTATAAGCATCTCCAT
TACTAAATAACCCAAGTGTTTCTCGAAGTACTGTAATTTAAAGAGATATTCGTAGAGGTA
M   I   Y   W   V   H   K   E   L   H   D   I   K   F   L   Y   K   H   L   H
```

FIG. 10D

```
      2290                2310                2330
        .         .         .         .         .         .
GCTACCCATCATATGTACAACAAGCAAAACACACTCTCTCCATTTGCCGGTATGTCAAAG
CGATGGGTAGTATACATGTTGTTCGTTTTGTGTGAGAGAGGTAAACGGCCATACAGTTTC
A  T  H  H  M  Y  N  K  Q  N  T  L  S  P  F  A

      2350                2370                2390
        .         .         .         .         .         .
CTATATGTTCTCAATCTAAATTCAAGAGCTTGTATCAATGGTGACTTCTTTACTTGATGT
GATATACAAGAGTTAGATTTAAGTTCTCGAACATAGTTACCACTGAAGAAATGAACTACA

      2410                2430                2450
        .         .         .         .         .         .
TTTTCGGGTTTTCAGGGCTCGCATTCCATCCGCTGGACGGGATACTTCAGGCTATACCGC
AAAAGCCCAAAAGTCCCGAGCGTAAGGTAGGCGACCTGCCCTATGAAGTCCGATATGGCG
               G  L  A  F  H  P  L  D  G  I  L  Q  A  I  P  H

      2470                2490                2510
        .         .         .         .         .         .
ACGTGATAGCGCTGTTTATAGTGCCGATTCATCTCATAACACATCTGAGTCTTTTGTTTT
TGCACTATCGCGACAAATATCACGGCTAAGTAGAGTATTGTGTAGACTCAGAAAACAAAA
  V  I  A  L  F  I  V  P  I  H  L  I  T  H  L  S  L  L  F  L

      2530                2550                2570
        .         .         .         .         .         .
TGGAAGGGATATGGACAGCAAGCATCCATGATTGCATACATGGtAACATCTGGCCTATAA
ACCTTCCCTATACCTGTCGTTCGTAGGTACTAACGTATGTACCaTTGTAGACCGGATATT
  E  G  I  W  T  A  S  I  H  D  C  I  H  G  N  I  W  P  I  M

      2590                2610                2630
        .         .         .         .         .         .
TGGGTGCAGGATACCATACCATACACCATACAACATACAAGCATAACTATGGTCATTATa
ACCCACGTCCTATGGTATGGTATGTGGTATGTTGTATGTTCGTATTGATACCAGTAATAt
  G  A  G  Y  H  T  I  H  H  T  T  Y  K  H  N  Y  G  H  Y  T

      2650                2670                2690
        .         .         .         .         .         .
CCATATGGATGGaCTGGATGTTTGGCTCTCTTATGGTTCCTTTAGCAGAAAAAGACAGTT
GGTATACCTACCtGACCTACAAACCGAGAGAATACCAAGGAAATCGTCTTTTTCTGTCAA
  I  W  M  D  W  M  F  G  S  L  M  V  P  L  A  E  K  D  S  F

      2710                2730                2750
        .         .         .         .         .         .
TCAAGGAGAAAGAAAAGTGAGAATGTTCAATGCTCACATGTATTCTTCATATGTTGCTCT
AGTTCCTCTTTCTTTTCACTCTTACAAGTTACGAGTGTACATAAGAAGTATACAACGAGA
  K  E  K  E  K  *

      2770                2790                2810
        .         .         .         .         .         .
TCTCGTGACTCTTATTAAAACCTTTCTAATCACTTTGGTGGAATTAAAAACATGACTGCA
AGAGCACTGAGAATAATTTTGGAAAGATTAGTGAAACCACCTTAATTTTTGTACTGACGT
```

FIG. 10E

```
      2830                2850                2870
         .         .         .         .         .         .
TAATTTGATGCAAAGTTTCAGACTTTTATTGCTAAAAATCTCTGATGATTATTAACCTCA
ATTAAACTACGTTTCAAAGTCTGAAAATAACGATTTTTAGAGACTACTAATAATTGGAGT

      2890                2910
         .         .         .         .
ATTATATAATTGcTGGATGAAGAGTTCAAATTTGGACTAAATCTG
TAATATATTAACgACCTACTTCTCAAGTTTAAACCTGATTTAGAC
```

FIG. 10F

```
1    maatmadynd qivnetsfyn rmvlshllpv nlweplphfl qtwlrnylag
51   nilyfisgfl wcfyiyylkl nvyvpkesip trkamllqiy vamkampwyt
101  llpavseymi ehgwtkcyst ldhfnwflcf lyialylvlv efmiywvhke
151  lhdikflykh lhathhmynk qntlspfagl afhpldgilq aiphvialfi
201  vpihlithls llflegiwta sihdcihgni wpimgagyht ihhttykhny
251  ghytiwmdwm fgslmvplae kdsfkekek
```

FIG. 11